vessel unless an electric field is present to remove them as they are set free; an expansion exceeding 1·25 gives, in the absence of such a field, fog or rain, according as the air is exposed to external ionising agents or not. The above three limits would correspond to adiabatic pressure falls of 27·7, 20·5, and 24·1 cm. of mercury respectively, if the initial pressure was 76 cm., and would vary with the initial pressure. The fog limit obtained by Prof. Barus for air exposed to X-rays or radium rays, except under conditions such that persistent nuclei resulted, generally lay between 19 and 21 cm., except when the radiation was exceedingly weak, when the limit approached that which he obtained for "non-energised" air, about 24 cm., which may be compared with the intermediate critical expansion mentioned above. The results of Prof. Barus are accounted for if we suppose that his method failed to detect the comparatively small number of drops formed on the spontaneously produced negative ions; such variation of the limit as was observed in air exposed to external radiation, as the intensity was varied within moderate limits, being what might be expected with a method in which the "fog limit" is only reached when a certain minimum number of drops is exceeded. It is true that the ions are not at any one moment all in an equally favourable condition for helping condensation, a certain range of expansions (not very wide, however) being required, for example, to catch all the negative ions; but there is no evidence that the efficiency of the ions as nuclei increases with the intensity of the ionising rays, if we leave out of consideration the possible effect of exceedingly intense rays; for the weakest radiation (that responsible for the "spontaneous" ionisation), as well as for radiation of very considerable intensity, the efficiency of the most favourably situated ions remains the same. Prof. Barus has apparently failed to notice that the limits found by him are, if properly interpreted, in fairly good agreement with those of previous observers—quite as good agreement as could be expected from the comparative roughness of his methods. Possibly some explanation of this omission is afforded by a passage on p. 50, where the volume change corresponding to a given pressure fall has been wrongly calculated, as if the expansion were isothermal instead of being nearly adiabatic.

It is a matter of some difficulty to know what views Prof. Barus really holds upon the relation of the ionisation as determined by electrometer measurements and the "fleeting nuclei" which "most physicists would call ions." That he does not regard such nuclei as identical with the ions is plain from the statement that the gamma rays, though weak ionisers, are strong nucleators, as well as from the suggestion that the fleeting nuclei produced by an X-ray bulb may be due to "a gamma-like ray," and only the persistent nuclei to the "X-light properly so called, which produces the well-known effects subject to the law of inverse squares" (the ionisation as determined by electrometer measurements being one of these, as another of the passages quoted seems to indicate). Prof. Barus seems to have entirely failed to realise how complete is the evidence of the identity of the nuclei produced, in the investigations of previous observers, by X-rays or any of the various types of Becquerel rays with the ions the existence of which has to be postulated to explain the phenomena of the conduction of electricity through the air exposed to such rays. Not only has it been shown by direct experiments that the nuclei are positively and negatively charged bodies having properties such as have to be assigned to the ions to explain the phenomena of conduction through gases, but a still more direct proof of the identity is furnished by the agreement of the two methods by which the charge on the ions was determined, that of J. J. Thomson and that of H. A. Wilson. For the former gives the ratio of the ionisation (the product of the number of the ions per c.c. and the charge carried by each), as determined by electrical methods, to the number of the nuclei, while the latter gives directly the actual charge of a single nucleus. Thus the number of nuclei, multiplied by the charge on each nucleus, is equal to the product of ionic charge and number of ions deduced from electrical measurements. The ionisation accounted for by the nuclei in question is thus equal to the ionisation determined by the electrical method.

Chapters iv. and v. contain an account of observations made at Providence and in the comparatively uncontaminated atmosphere of Block Island upon the variations in the number of nuclei in unfiltered atmospheric air. The nuclei are here such as may be caught with smaller expansions than are required by the ions; they are Aitken's "dust" particles. Their number was estimated, not by Aitken's method, but by observing the coronas seen through the fogs produced on expansion of the air in an apparatus of the same type as that used in the investigations already discussed. In the present case, where only easily caught nuclei are involved, the objections brought above against the method do not apply, and there can be no doubt about the importance of such investigations.

C. T. R. WILSON.

BOTANICAL CONGRESS AT HAMBURG.

THE Society of Applied Botanists held its annual conference at Hamburg in September, and the Society of Systematic Botanists held its meeting there at the same time. Some 150 botanists in all, mostly interested in applied botany, attended. The choice of place of meeting was a happy one, as in Hamburg, the chief Continental port, the closest connection can be seen between commercial and scientific activities.

All the botanical institutions are under the direction of Prof. Zacharias, and while the educational requirements are well cared for, everything that the botanical scientific staff can do to foster the trade of the city is done. The seed-testing station is under the direct charge of Prof. Voigt, who, with six assistants, tests some 1500 samples of seed, oil-cake, &c., each year. An important export seed trade with the Argentine Republic is carried on, the certificates required by the Republic being supplied from the station. Another important institution is the Station for Plant Protection, founded some seven years ago as a means of protection for the vineyards and orchards of Germany against the San José scale insect and other pests liable to be imported into Germany on American apples, fruit-trees, &c. This station is in charge of Dr. Brick, who, armed with the necessary staff, library, and apparatus, must report on every barrel of apples coming into port. The rejected apples, dangerous to Germany, find a ready market in England and elsewhere.

In the Botanical Museum the collections are arranged in two sections. One part follows the usual lines—the specimens are arranged in systematic order, according to their natural affinities, and serve more especially for educational purposes. The other part of the collection appeals to commercial interests. The fibres of commerce, the chief rubbers, gums, resins, cereals, &c., are in each class grouped together, regardless of natural affinities, and solely for trade purposes. A new and more commodious museum in the Botanic Gardens is just reaching completion. The museum is regularly visited by schools and their teachers, and a large piece of ground is set apart in the suburbs to supply the specimens required in the schools for teaching purposes.

Everything that could be was done by the local botanical staff and others to make the meetings of the societies a success. The Hamburg Government granted a sum of 4000 marks toward expenses, and in other different ways showed a practical interest in the proceedings. One important feature was the first International Conference on Seed Testing. Most of the seed stations in the world were represented, and attempts to establish a uniform system of testing, applicable in different countries, were discussed. It was generally felt that it would be premature to seek to go further at present than simple discussion. Many valuable papers were contributed. Dr. Stebler gave the results of twenty years' investigation in the station at Zürich as to the country of origin of the seeds of commerce, judged sometimes from the particles of soil found in the impurities (!), but more usually from the weed-seeds present. This paper was fully illustrated by dried plants and seeds. Dr. von Weinzierl, of Vienna, dealt with sugar-beet and mangel seeds; Dr. Degen, of Budapest, with dodder in clover; Prof. Rodewald, of Kiel, with the sources of error in seed-testing; while Prof. Voigt, of Hamburg had pre-

pared a comparative report embodying the rules governing seed-testing in Germany, Russia, Scandinavia, and the United States of America. Surprise was expressed that there was only one Government seed station in the United Kingdom—that in the present writer's charge in Dublin, where during the past year 1476 samples were examined.

A paper which aroused considerable interest was that by Prof. Warburg urging the claims of tropical agriculture on behalf of the German colonies, and the conference adopted resolutions urging the necessity of:—(1) The erection of a central imperial institute in connection with the Biological Institute at Dahlem, for the study of tropical agriculture and forestry. (2) Conversion of the botanical garden in Victoria, in the Cameroons, into an agricultural institute of the first order. (3) Foundation of similar institutes in Togo and the South Sea Islands. Prof. Warburg thought that a banana trade in German West Africa could be developed, that rubber could be made available in increasing quantities by cultivation of rubber trees, and that mistakes had been made by attempts to apply to tropical countries the crops and methods of cultivation found to succeed in Germany.

Many important papers on other subjects by Profs. Drude, Zacharias, Aderhold, Appel, Vañha, &c., were read, but limitations of space prevent further mention here. A detailed official report is in course of preparation. The systematists, with Dr. Engler as president, devoted one day to the Heide near Wintermoor, where, under Dr. Graebner's guidance, fine specimens of native Juniperus, and many other features, wild and cultivated, of the moor, which is of enormous extent, were seen. While attempts are being made to restore to profitable cultivation land which is now in possession of heather, and was formerly covered with oak and beech, one portion, some fifty acres in extent, near Totengrund, has been bought by Prof. Thomsen, of Münster, and presented by him to the nation as a permanent "nature memorial."

T. J.

METEOROLOGICAL OBSERVATIONS.

TERRESTRIAL Physics in Messina.—The *Annuario* of the Messina Observatory for the year 1905 shows that Prof. G. B. Rizzo has made a good beginning in the important task recently imposed upon him by the faculty of the university. The climate of Sicily is fairly well known so far as the principal towns are concerned, thanks to the efforts of the directors of the large observatories of Palermo and Catania and others, but, as Prof. Rizzo points out, little or nothing is known about the conditions of the other parts of the island. To remedy this want a number of rainfall and temperature stations have been established during the last year in the province of Messina, and have recorded observations from the beginning of 1906. On the initiative of the International Meteorological Committee, the Solar Committee of which Sir Norman Lockyer is president is carrying out an important study of the connection of solar and terrestrial phenomena; for Italy, Prof. Riccò at Catania and Prof. Rizzo at Messina are actively engaged in the investigation on the general plan laid down by the committee. For the study of earthquake phenomena one of Vicentini's microseismographs has been erected; in connection with this subject Prof. Rizzo is investigating the facts relating to the terrible Italian earthquake of September, 1905, with the cooperation of more than eighty observatories in various parts of the world. The seismograms show that the disturbance was felt from Norway to the Cape of Good Hope, and from California to New Zealand. The complete results will shortly be published.

Meteorology in the United States.—The report of the U.S. Weather Bureau for the fiscal year 1904–5 (pp. xxiv+384) gives a brief survey of the development of the weather service during ten years' administration of the present chief (Prof. W. L. Moore). The magnitude of the work now performed by it is almost astounding; indeed, Prof. Moore claims that in the results accomplished for the benefit of the farmer, the sailor, the seeker after health or pleasure, and others, there is no weather service in the world comparable with it. The estimated amount of the expenditure for the year exceeded 278,000*l.*, and the appropriation for the following year, including the support of Mount Weather Observatory (Virginia), an institution devoted purely to meteorological research, exceeded 290,000*l.* The supervising director of that observatory is Dr. W. J. Humphreys, late professor of physics in the University of Virginia, and Prof. Moore states that Mount Weather may be expected to do as much for the science of meteorology as the service has already done for the material interests of the United States. It is stated that the daily distribution of weather forecasts and charts has increased to nearly 623,000, of which 158,000 represent printed reports. Weather maps are printed at nearly 100 local stations, and daily telegraphic reports are received from the Azores and west coasts of Europe, and the Bureau has developed one of the best wireless systems now in use. The Navy Department has instructed its wireless stations to receive and promptly transmit to the ocean or other places where the information can be made useful the storm warnings of the Weather Bureau, and has requested vessels having the use of its wireless stations to take observations and to transmit them to the Bureau, *without charge against the Department of Agriculture.* With a further extension of wireless telegraphy, it is thought that the reports will render possible a storm-warning service for the western coasts of Europe and for vessels in mid-ocean. Arrangements have been made for aërial research by liberating unmanned balloons from many stations, in cooperation with those at Mount Weather.

The last semi-annual Bulletin of the Colorado College Observatory contains the annual meteorological summary for 1905. The present observatory, erected in 1894, is about 6040 feet above sea-level, and was the gift of Mr. H. R. Wolcott, of Denver; the director is Dr. F. H. Loud. It is well equipped with astronomical and self-recording meteorological instruments; the college became a voluntary station of the U.S. Signal Service in 1878. The mean temperature of the year 1905 was 46°·1, mean maximum 58°·8, minimum 33·5, absolute maximum 91°, in June and August, minimum −22°, in February. The yearly rainfall was 15·9 inches, number of rain-days 70. The Bulletin also contains monthly summaries of weather records at Colorado Springs between 1872 and 1903, which have been collected from various sources with considerable labour by Mr. C. M. Angeli, and prepared for press by Mr. C. D. Child; their present publication is merely preliminary, in view of numerous demands for historical information, and is subject to later revision.

Observations in Mauritius.—The annual report of the director of the Royal Alfred Observatory, Mauritius, for 1905, shows that the rainfall there was much above the average of the last thirty years, viz. 67·90 inches as compared with 48·27 inches; in January the fall was 21·16 inches, or 12·77 inches above the normal, and is the greatest on record. The maximum shade temperature was 89°·0, in November, and the minimum 52°·3, in August; the highest temperature in the sun's rays was 156°·4, in January, the highest on record being 165°·5, in February, 1898. From observations obtained from ships' logs, the tracks of seven cyclones in the Indian Ocean were laid down; 474 photographs of the sun were sent during the year to the Solar Physics Committee. Fifty-three earthquakes were recorded. The registered velocity of the wind was below the average in every month except April; Mr. Claxton remarks that a comparison of the records of the Robinson and Dines anemometers in use at the observatory in the years 1904–5 indicates that one or both are untrustworthy as standard instruments.

Rainfall in German South-West Africa in 1904–5.—Notwithstanding the considerable damage and loss of records due to the rebellion of several tribes, complete results from twenty-eight stations are published in *Wissenschaftliche Beihefte zum deutschen Kolonialblatte*, Band xix., 2 Heft. The total number of stations which have suffered during the last two years amounts to forty, but steps are being taken to replace the instruments as soon as practicable. The rainfall of the year in question was, on the average, only about three-fourths of that in the previous year—in the central and southern parts only about one-half. The principal rains fall between January and March; the greater